The transformation of Chinese agriculture

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Introduction

- In the analysis of change in poverty and inequality over time, we already saw evidence that growth in Chinese agriculture had a dramatic impact (in fact, the largest impact) on poverty reduction, compared to growth in other sectors.
- This serves as a clue that growth in Chinese agriculture has been significant, and that it has had dramatic implications for the welfare of Chinese households – particularly rural households.
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Agriculture in the pre-reform period

- The increase in agricultural production in the pre-reform Socialist period was steady: grain yields had an annual growth rate of 2.8%, grain production by 2.5%.
- However, average level of consumption for households (in terms of caloric intake) remained low, particularly in rural areas.
- In addition, China witnessed a dramatic famine during 1959-61 (during the Great Leap Forward); more than 30 million people died, rendering this the worst famine in history.
- Sharp reductions in both agricultural production and food availability were to blame.

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Summary statistics: Agriculture under socialism

Table 13.1. *China's agricultural performance during the Socialist Era, 1950–1978*

	Grain			Cotton			Structure of cropping (grain-sown area/total sown area)
Year	Sown area (million hectares)	Output (million tons)	Yield (ton/ hectare)	Sown area (1,000 hectares)	Output (1,000 tons)	Yield (ton/ hectare)	
1950	114.41	132.13	1.16	3,786	692	0.180	87
1951	117.77	143.72	1.22	5,485	1,031	0.188	87
1952	123.98	163.91	1.32	5,576	1,304	0.233	88
1953	126.64	166.83	1.32	5,180	1,175	0.225	88
1954	128.99	169.51	1.31	5,462	1,065	0.195	87
1955	129.84	183.93	1.42	5,773	1,518	0.263	86
1956	136.34	192.75	1.42	6,256	1,445	0.225	86
1957	133.63	195.05	1.46	5,775	1,640	0.278	85
1958	127.61	197.65	1.55	5,556	1,969	0.353	84
1959	116.02	169.65	1.46	5,512	1,709	0.308	81
1960	122.43	143.85	1.18	5,225	1,063	0.203	81
1961	121.44	136.50	1.13	3,870	748	0.195	85
1962	121.62	154.40	1.27	3,497	702	0.203	87
1963	120.74	165.75	1.37	4,409	1,137	0.255	86
1964	122.10	180.87	1.54	4,935	1,663	0.338	85
1965	119.63	194.53	1.63	5,003	2,098	0.420	83
1966	120.99	214.00	1.77	4,926	2,337	0.473	82
1967	119.23	217.82	1.83	5,098	2,354	0.465	82
1968	116.16	209.06	1.80	4,986	2,354	0.473	83
1969	117.60	210.97	1.79	4,829	2,079	0.428	83
1970	119.27	242.92	2.04	4,997	2,277	0.458	83
1971	120.85	250.14	2.07	4,924	2,105	0.428	83
1972	121.21	240.47	1.98	4,896	1,958	0.398	82
1973	121.16	270.16	2.19	4,942	2,562	0.518	82
1974	120.98	275.28	2.27	5,014	2,461	0.488	81
1975	121.06	284.51	2.35	4,956	2,381	0.480	81
1976	120.74	286.31	2.37	4,929	2,055	0.420	81
1977	120.40	282.73	2.35	4,845	2,049	0.420	81
1978	120.59	304.77	2.53	4,866	2,167	0.443	80

Source: Yearbook (various years).

Agricultural institutions in the pre-reform period

- Upon seizing power, the CCP first implemented a comprehensive land reform; land was seized from landlords and rich farmers and divided among all rural households.
- Quickly, however, this private land ownership system was undercut; farmers were organized into cooperatives, and then into larger communes.
- In this system, farmers weren't the residual claimants from production, and decisions were often centralized – both leading to inefficiencies.
- Instead, they were paid on the basis of a workpoint system.

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Pricing and marketing of commodities

- Prices for output were fixed by the state, and rarely changed.
- Almost all production was sold to the state at low prices; the state, in turn, sold these staples at low prices to urban households using ration coupons.
- There was a severe shortage of inputs.
- In addition, the hukou registration system tied rural households to their villages, preventing them from migrating.

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Agriculture in the reform period

- Annual growth rates of agriculture increased dramatically in the reform period: to 8.2% annually between 1978 and 1984, and 4% annually between 1985 and 2000.
- In addition, there was extremely rapid growth in cash and other non-grain crops.
- At the same time, rapid growth across other sectors rendered agriculture less and less important in the overall Chinese economy.

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Summary statistics: Agriculture in the reform period

Table 13.3. *Annual growth of Chinese agriculture by commodity, 1970–2000*

	Pre-reform period	Reform period		
Commodity	1970–1978	1978–1984	1985–1995	1996–2000
Agricultural GDP	4.9	8.8	3.8	4.2
Grain				
Production	2.8	4.7	1.7	0.03
Sown area	0.0	−1.1	−0.1	−0.14
Yield	2.8	5.8	1.8	0.17
Rice				
Production	2.5	4.5	0.6	0.3
Sown area	0.7	−0.6	−0.6	−0.5
Yield	1.8	5.1	1.2	0.8
Wheat				
Production	7.0	8.3	1.9	−0.4
Sown area	1.7	−0.0	0.1	−1.4
Yield	5.2	8.3	1.8	1.0
Maize				
Production	7.4	3.7	4.7	−0.1
Sown area	3.1	−1.6	1.7	0.8
Yield	4.2	5.4	2.9	−0.9
TOTAL (cash crop sown area)	2.4	5.1	2.1	3.5
Cotton				
Production	−0.4	19.3	−0.3	−1.9
Sown area	−0.2	6.7	−0.3	−6.1
Yield	−0.2	11.6	−0.0	4.3
Edible oil crops	2.1	14.9	4.4	5.6
Vegetable area	2.4	5.4	6.8	9.5
Fruit				
Orchards area	8.1	4.5	10.4	1.5
Outputs	6.6	7.2	12.7	8.6
Meat (pork/beef/poultry)	4.4	9.1	8.8	6.5
Fishery	5.0	7.9	13.7	10.2

Notes: Values are in percent. Growth rates are computed using the regression method. Growth rates of individual items and groups of commodities are based on production data; sectoral growth rates refer to value added in real terms.

Source: Yearbook (1980–2001), Agriculture Yearbook (1980–2001).

Summary statistics: Structural change in China's economy

Table 13.6. *Structural change in China's economy, 1970–2000*

	1970	1980	1985	1990	1995	2000
			Share in GDP			
Agriculture	40	30	28	27	20	16
Industry	46	49	43	42	49	51
Services	13	21	29	31	31	33
			Share in employment			
Agriculture	81	69	62	60	52	50
Industry	10	18	21	21	23	22.5
Services	9	13	17	19	25	27.5

Note: Values are in percent.

Source: Yearbook and Rural Statistics Yearbook (various issues).

Production and marketing environment

- There have been dramatic changes in the role of government in agricultural and marketing.
- A large majority of sales of grains, oilseeds and fiber, and all sales of horticultural and livestock producers, flow to private traders; the government still purchases around 20-30% of grain at a below-market price.
- With the combination of rising productivity, production of higher-value crops and livestock, higher output prices and the expansion of off-farm work, rural incomes have risen dramatically.

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Summary statistics: Increases in rural income

Table 13.9. *Rural income per capita in China, 1980–2001 (real terms, 2000 yuan)*

Income group	1980	1985	1990	1995	2000	2001	Annual growth rate, 1980–2001 (%)
Average	711	1,248	1,305	1,702	2,253	2,347	6
Bottom decile (poorest)	312	448	442	493	579	578	3
Top decile (richest)	1,530	2,486	3,253	4,763	6,805	7,159	8

Source: Yearbook (various issues).

This unit's papers

- In order to understand the agricultural sector in China better, we will examine two papers.
- The first is an older, macro-level paper by Justin Lin that seeks to analyze determinants of growth at the provincial level in the early years of reform.
- The second is a newer, micro-level paper written by me that analyzes the impact of insecure property rights on agricultural outcomes at the micro level in more recent years.

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Lin, Rural reforms and agricultural growth in China

- This paper seeks to analyze agricultural growth during the earliest period of reform in China, 1978-1984.
- Lin is particularly interested in identifying the contribution of decollectivization, price adjustments and other reforms to China's agricultural growth.
- He uses a production function approach and provincial-level data from 1970 to 1987.

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Primary specification

- More specifically, he estimates the following specification.

$$\begin{aligned} \ln Y_{it} &= \alpha_1 + \alpha_2 \ln Land_{it} + \alpha_3 \ln Labor_{it} + \alpha_4 \ln Capital_{it} + \alpha_5 \ln Fert_{it} \\ &+ \alpha_6 HRS_{it} + \alpha_7 MP_{t-1} + \alpha_8 GP_t + \alpha_9 NGCA_{it} + \alpha_{10} MCI_{it} \\ &+ \alpha_{11} t_t + \sum_{j=12}^{39} \alpha_j D_j + \epsilon_{it} \end{aligned}$$

- These are standard agricultural inputs, plus six other variables: proportion of teams that have changed to household responsibility system (HRS), index of market prices relative to input prices (MP), index of above-quota prices relative to input prices (GP), percentage of sown area in nongrain crops (NGCA), multiple cropping index (MCI), and time trend T.

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Primary specification, cont.

- Lin then uses the results of the production function estimation to estimate how much of the observed growth is attributable to various causes: growth in inputs, institutional reforms, and a productivity residual.
- He also separates this into the earliest years of reform (pre-1984) and subsequent years; they ultimately have very different patterns.

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Discussion questions

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- This paper uses relatively straightforward specifications; key questions to analyze include the following.
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- Lin's paper analyzes a rapid process of liberalization in the early reform period.
- However, China's rural sector is by no means fully liberalized; in particular, Chinese rural households still live under an arguably somewhat unusual regime of partially collective property rights, and this may have substantial implications for their economic decision-making.
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Changing land rights in China

- Land was collectivized in China between 1958 and 1979.
- From 1979 to 1983, the Household Responsibility System was implemented, returning (partial) use rights over land to individual households; title is retained by the village collective.
- There is no private land market; periodic reallocations are primary threat to households' security of tenure.

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Reallocations: a brief description

- The stated purpose of reallocations is to promote equity and to accommodate demographic shifts in the absence of a land market.
- Village leaders may also use reallocations to extract rents.
- Literature and prior surveys suggest reallocation entails full swaps of land between households; both households that net gain land and households that net lose land, lose their original plot.

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Optimizing the choice of reallocation

- Assume official chooses whether to hold a reallocation; he perceives benefits B, including rent-seeking, increased equity, improved match between households and plots.
- There is a transactional cost T, larger in areas with higher topographic variability.

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Comparative statics

- The official will reallocate if $B > T + C$.
- Reallocations should be less common given a larger predicted decline in output, and less common given rugged topography.
- In addition, the official who chooses to conduct a reallocation then faces a second margin of optimization.
  - How to adjust landholdings, and for which households.

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Optimizing household-level land shifts

- Probability household i will have its land reallocated denoted D_{ivt}.
- D_{ivt} defined as function of covariates X_{ivt}, conditional on $R_{vt} = 1$.
- R_{vt} denotes reallocation at village-year level.

$$\begin{aligned} D_{ivt} &= f(X_{ivt}) \text{ if } R_{vt} = 1 \\ D_{ivt} &= 0 \text{ if } R_{vt} = 0 \end{aligned}$$

- X_{ivt} is defined flexibly, but can include demographic characteristics; household's position in the overall land distribution, given official's potential interest in equity; and past history of land shifts.

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- X_{ivt} is defined flexibly, but can include demographic characteristics; household's position in the overall land distribution, given official's potential interest in equity; and past history of land shifts.

Optimizing household-level land shifts

- Probability household i will have its land reallocated denoted D_{ivt}.
- D_{ivt} defined as function of covariates X_{ivt}, conditional on $R_{vt} = 1$.
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- Thus they have differentially greater security, compared to their neighbors in the same village and year.
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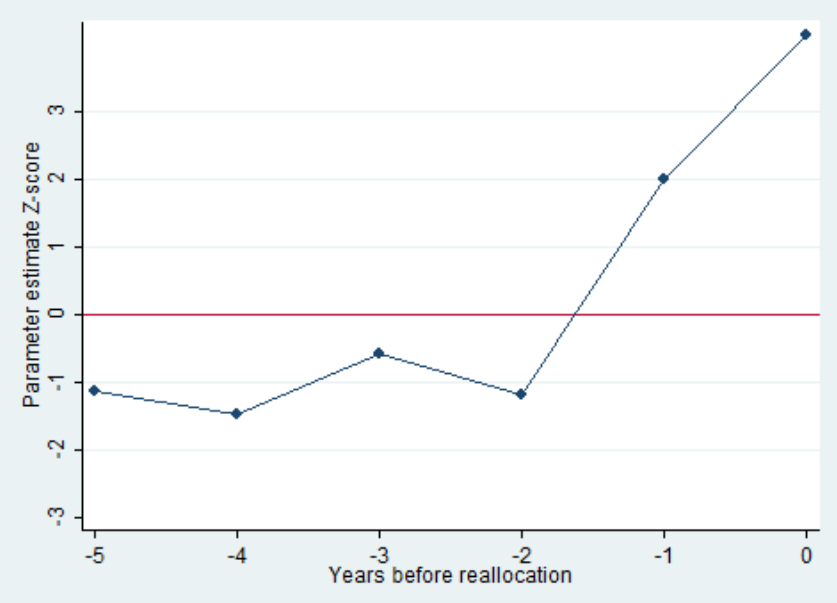
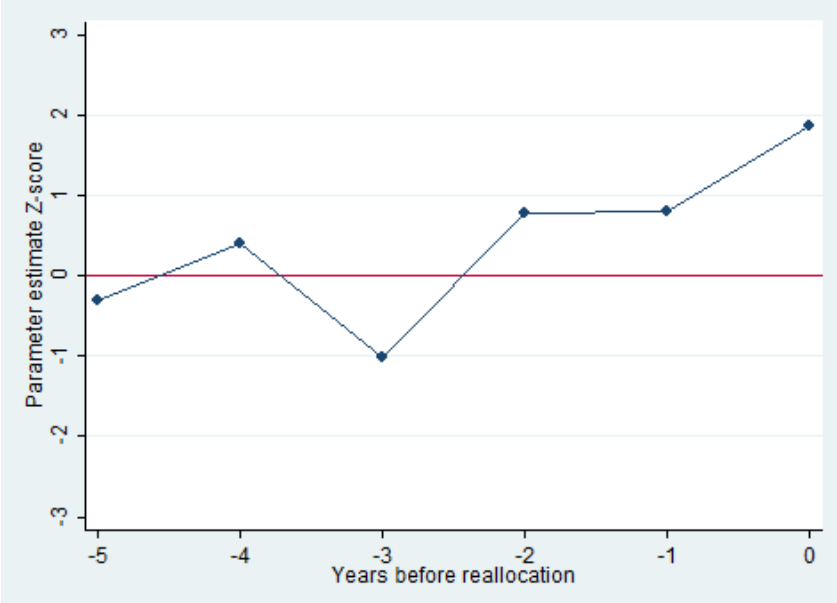
Trends in non-reallocation years



(a) Area sown



(b) Fertilizer

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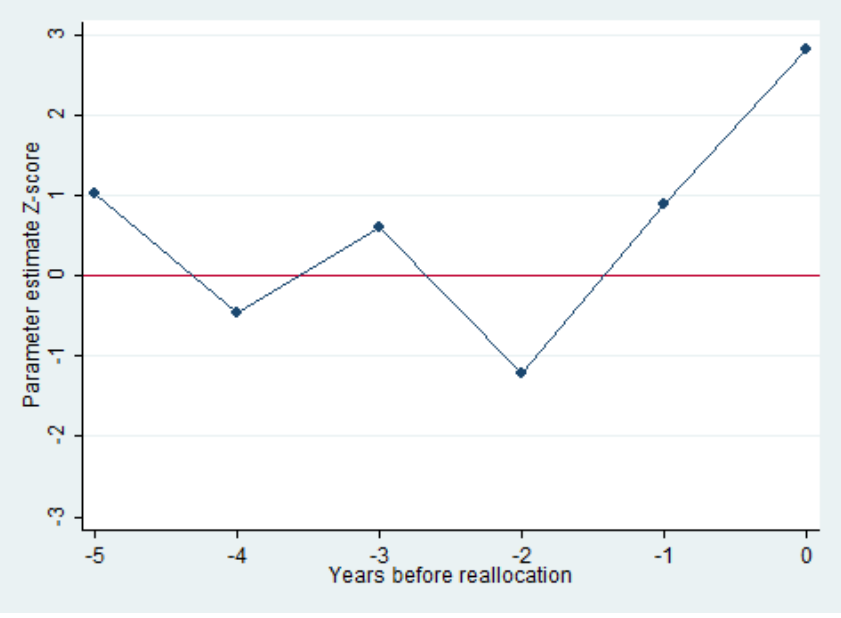
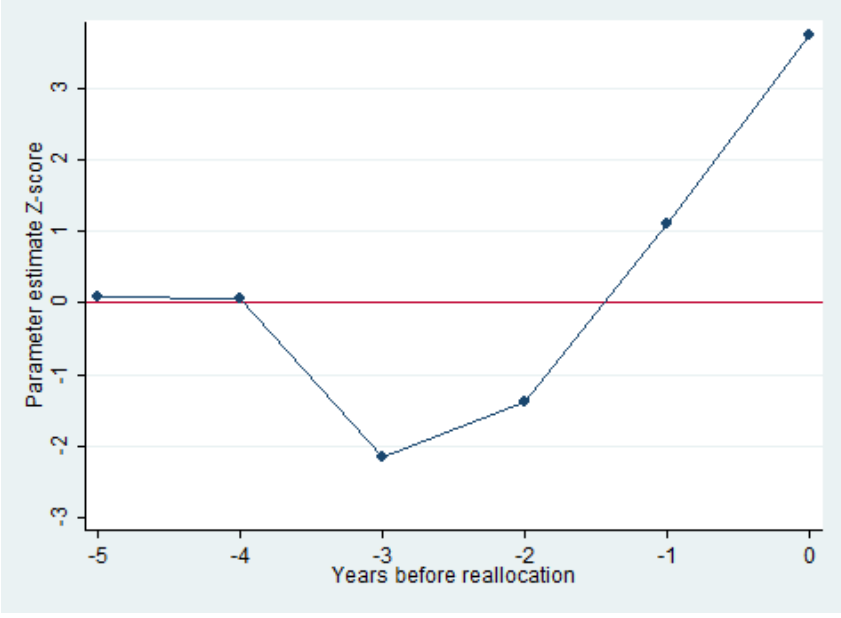


(c) Agricultural production



(d) Agricultural labor

Estimating equation

- The estimating equation is as follows.

$$Y_{ivpt} = \beta_1 D_{ivpt}^{-1} \times R_{vpt} + \beta_2 D_{ivpt}^{-1} + \beta_3 X_{ivpt} + \beta_4 R_{vpt} + \nu_i + \gamma_{pt} + \sum_{i=1}^{10} F_v t + \epsilon_{ivpt}$$

- The primary independent variable of interest is $D_{ivpt}^{-1} \times R_{vpt}$: this captures the differential outcomes for households previously included in a reallocation, in the year of the next reallocation.
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An alternate lens

- You can also consider this to be parallel to a dif-in-dif analysis: I analyze the difference in investments between households previously included in a reallocation and those not previously included, comparing across reallocation years and non-reallocation years.
- **But**, the category "previously included in a reallocation" is not fixed over time.
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- One important dimension here is that households "previously included" in a reallocation includes households who lost land **and** households who gained land.
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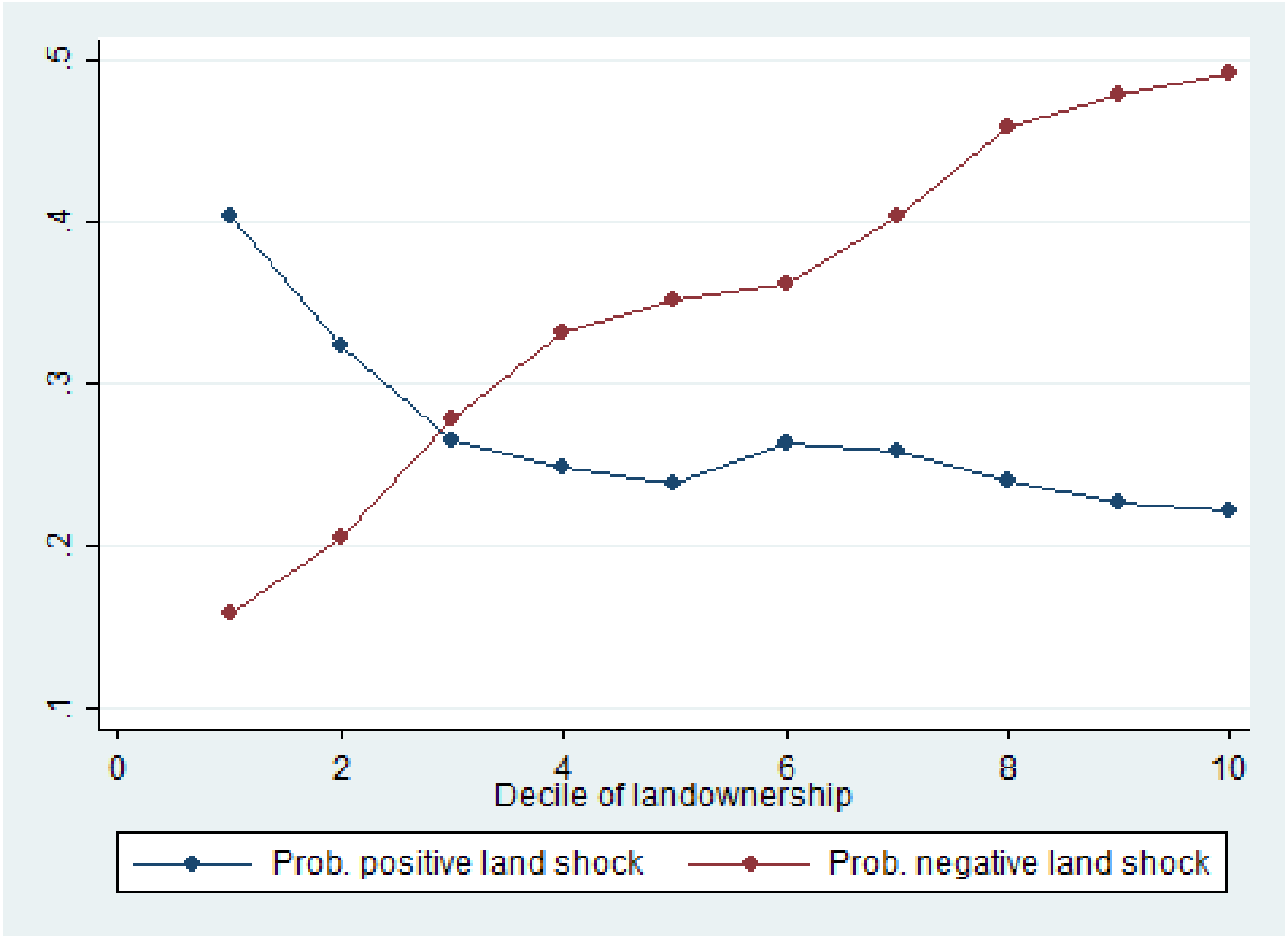
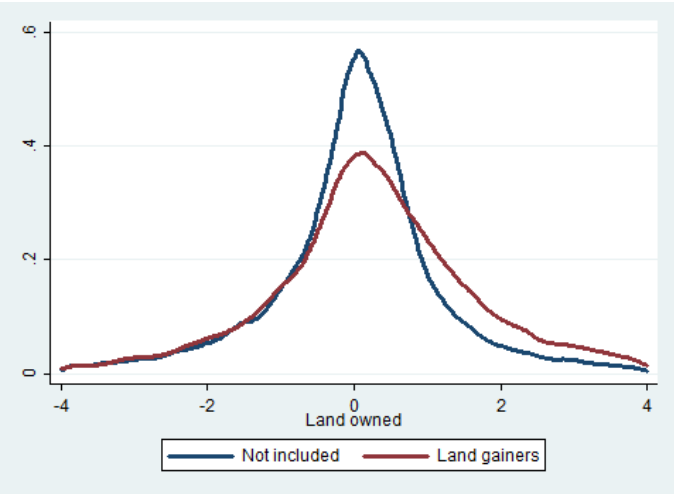
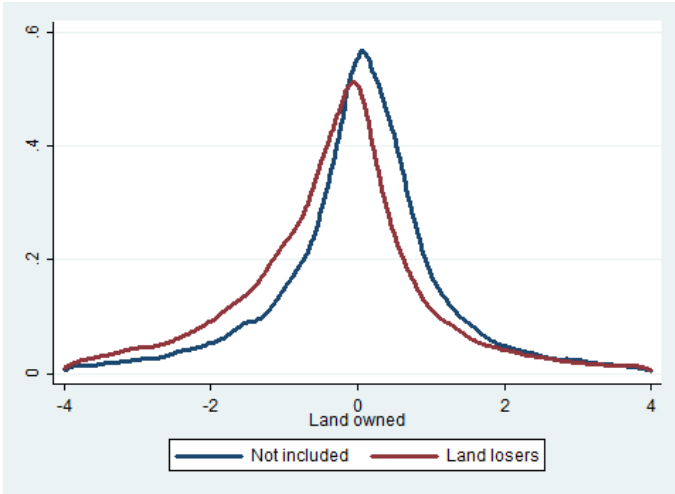
Probability of reallocation by decile of landownership



Kernel density estimates of landholding distributions



(e) Land gainers



(f) Land losers

Bias, cont.

- The hope is that even if land losers are different from households that are not included, and land gainers are also different, the only **shared** characteristic that gainers and losers have relative to households not previously included is differential property rights.
- You can assess the plausibility of this hypothesis, and the evidence I present that is consistent with it, when reading the paper.

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More discussion questions

- What types of investments seem to be responsive to variation in property rights, and what types are not? Are these results consistent with our intuition?
- What else could be done to verify that households who have stronger or weaker property rights are similar along other dimensions?
- What are the policy implications of these results? Can we use them to estimate the impact of endowing rural Chinese households with full property rights?

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Relationship between agriculture and other sectors

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- At the same time, access to off-farm opportunities seems very important for increases in rural income – and how do individuals have capital to invest in non-agricultural opportunities?

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Broader motivation in development economics

- Evidence from a variety of contexts (not only China) suggests rural households cannot easily exit low-return forms of agricultural production and exploit higher-return opportunities.
- Are rural households trapped in agriculture (and thus in poverty)?
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- This paper exploits the evolution of an unusual grain procurement system in China to evaluate the effect of a positive lump-sum income shock on rural households.
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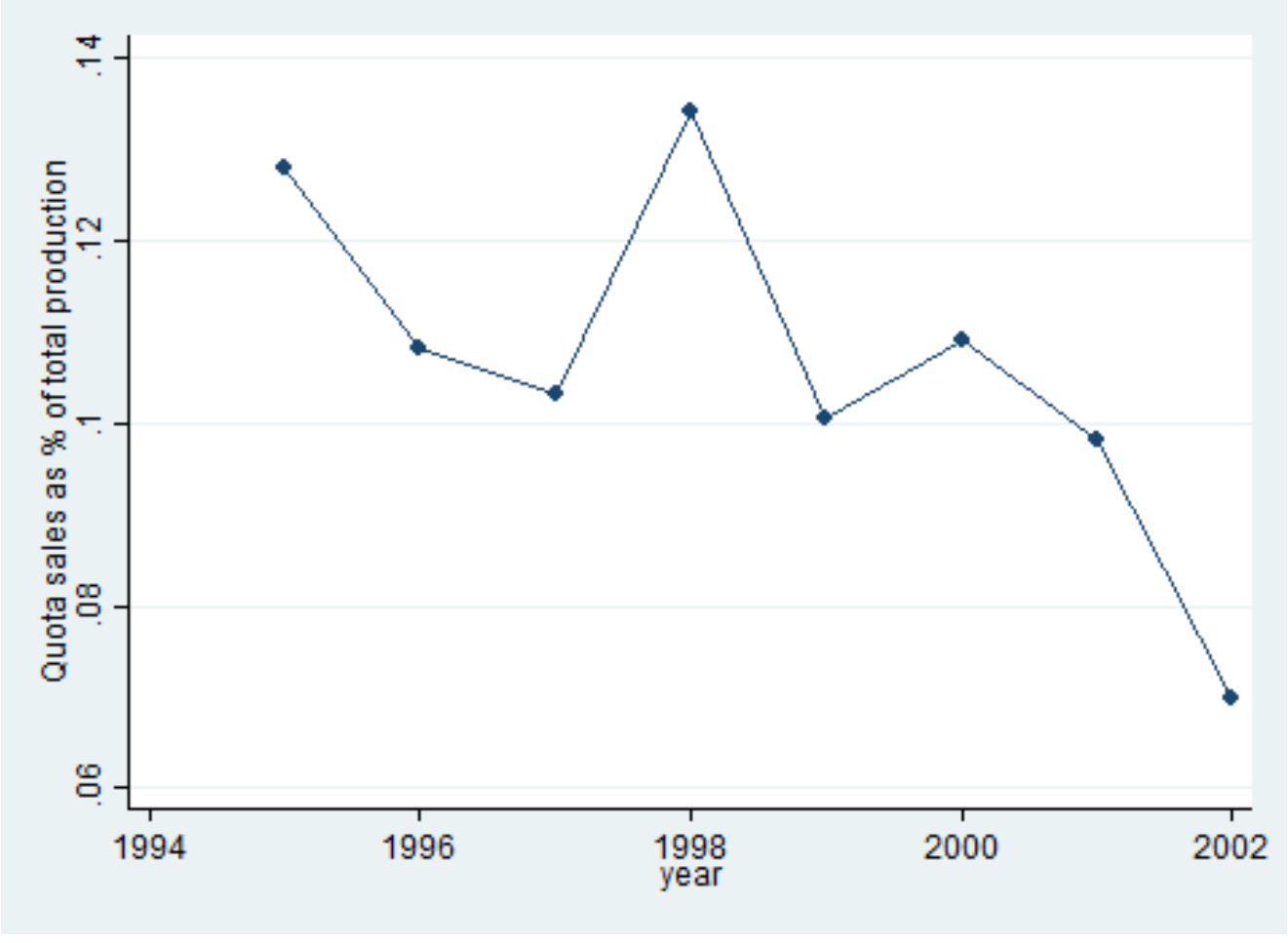
Quota sales over time



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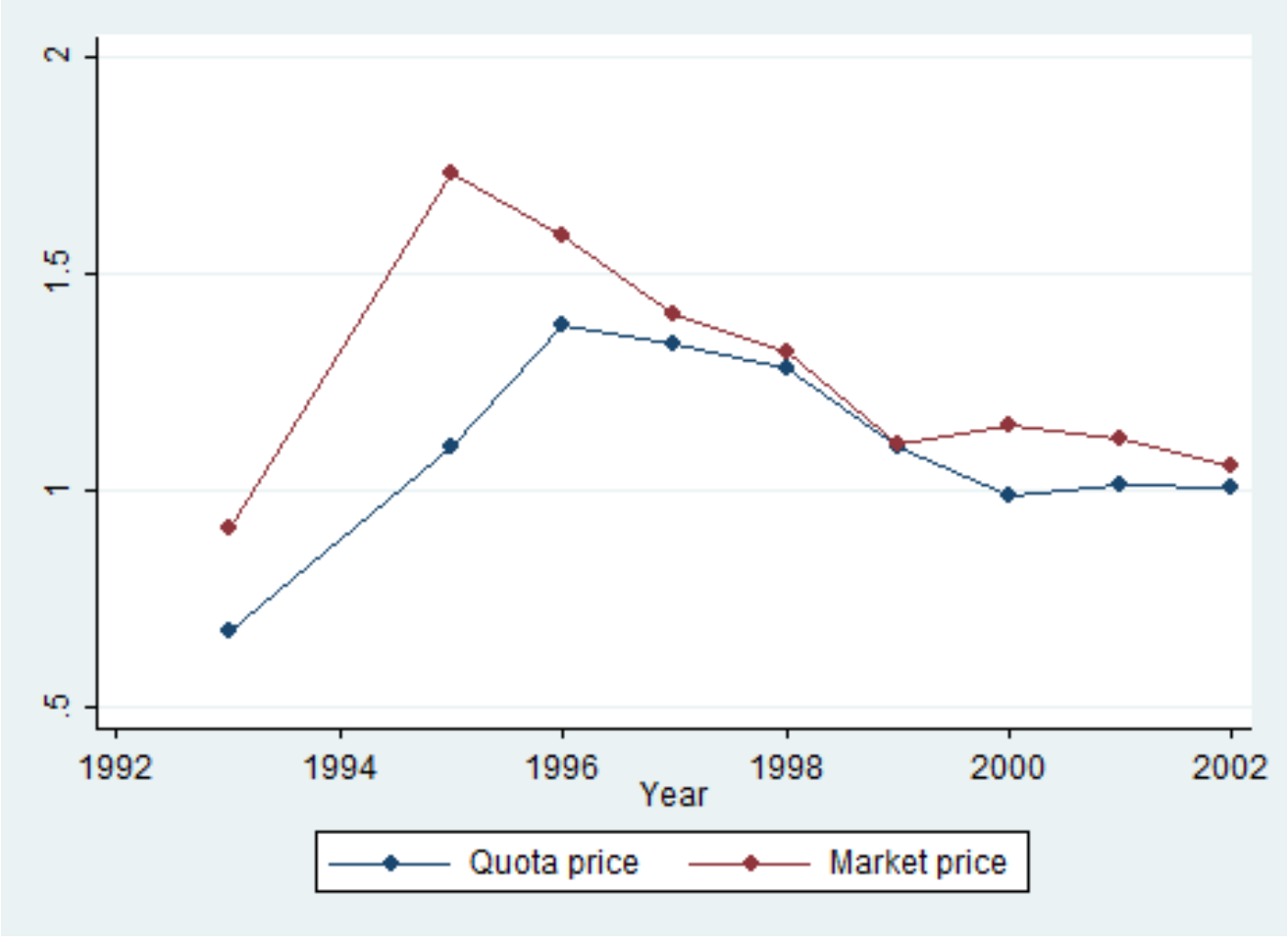
Evolution of quota prices



Identification strategy: overview

- A variety of analysts have noted that the government's grain policy was consistently harsher in its treatment of rice producers relative to wheat, maize or soybean producers.
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Variation in change in quota prices over time

- However, directly estimating the impact of higher quota income on economic outcomes is subject to a strong selection bias due to the endogenous determination of quota quantity.
- Accordingly, my objective is to identify a quasi-exogenous source of variation in propensity to cultivate rice, and thus in quota quantity.
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First stage

- The interaction $Clim_{vp} \times \tilde{P}_{vpt}$ is then employed an instrument for quota income conditional on province-year and village fixed effects.
- The postulated first stage can be written as follows, where I_{ivpt} denotes quota income:

$$\begin{aligned} I_{ivpt} &= \beta Clim_{vp} \times \tilde{P}_{vpt} + \lambda_{vp} + \nu_{pt} + Clim_{vp} \times P^{sum}_{ivpt} \\ &+ \eta^{clim}_{vp} \times P^{g}_{ivpt} + \eta^{ind}_{vp} \times \gamma_t + \epsilon_{ivpt} \end{aligned}$$

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OLS vs. 2SLS

- The ordinary least squares specifications examine the impact of higher quota income without correcting for the selection bias inherent in the selection of villages that have higher quota quantities.
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Estimating equation

- The equation of interest regresses economic outcomes on lagged quota income in hundreds of yuan, with village and province-year fixed effects and the same controls included in the first stage.

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Results: Summary indices

	Agri. prod. (1)	Agri. input (2)	Non-agri. (3)	Outside labor (4)	Migration (5)	Borrowing (6)	Grain cons. (7)	Other cons. (8)
				OLS				
Quota income	.491 (.074)***	.408 (.064)***	.005 (.009)	.060 (.012)***	-.007 (.013)	.005 (.003)*	.226 (.034)***	.055 (.013)***
Obs.	16188	16188	16188	16188	16188	16188	16188	16188
				Two-stage least squares				
Quota income	-.916 (.358)**	-.970 (.313)***	.559 (.321)*	-.105 (.229)	.199 (.204)	.082 (.043)*	.037 (.157)	.217 (.089)**
Obs.	16188	16188	16188	16188	16188	16188	16188	16188

Summarizing results

- The results show a decline in agricultural production of one standard deviation and an increase in non-agricultural investment of .4 standard deviation for each 100 yuan of quota income.
- These results are consistent with the hypothesis that households are initially too poor to enter non-agricultural production.
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Comparing the OLS and 2SLS results

- The differences between the two sets of estimates are generally consistent with the evidence of differential trends for high quota quantity villages.
- Households with greater quota quantities early in the period show more rapid increases in agricultural area and production, agricultural inputs, and grain consumption.
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